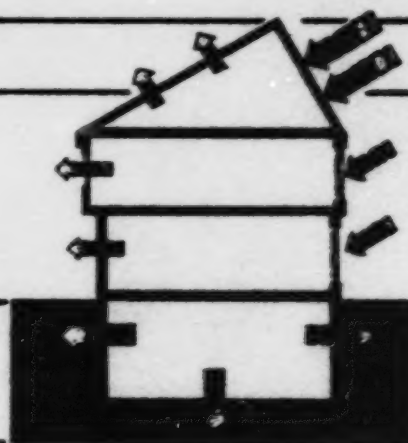

REPORT OF THE

ENERGY MINES AND RESOURCES CANADA

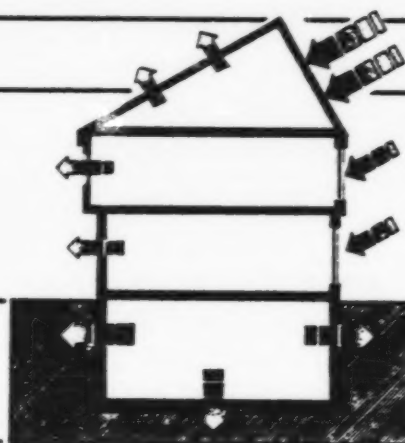
RESIDENTIAL

ENERGY AUDIT

SEMINAR



REPORT OF THE
ENERGY MINES AND RESOURCES CANADA
RESIDENTIAL
ENERGY AUDIT
SEMINAR



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This Residential Energy Audit Seminar was held in Camsell Hall at the offices of Energy Mines and Resources Canada (EMR), 580 Booth Street, Ottawa on October 22nd, 1981.

The Buildings and Urban Energy Directorate of the Conservation and Renewable Energy Branch (CREB) organized this seminar with the participation of interested commercial, research and governmental organizations and individuals from Ottawa, the Provinces, and the United States.

A list of approximately 80 participants and their addresses are included in this report in Appendix "A".

The seminar was chaired by Mr. David McCann, Chief, Policy and Programs Development, Existing Residential, CREB.

PURPOSE AND AGENDA

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The purpose of the seminar was to share information and approaches to future co-operation amongst those experienced with residential energy audits/surveys and EMR Canada who is involved in researching the feasibility of an audit service in potential conjunction with other energy conservation programs.

The main body of the seminar focussed around four panels whose members each made brief presentations followed by discussion of the points raised by the panel as a whole. Generally each panelist outlined their recent, current and planned activities in the area of energy audits (or surveys as many called them). At the end of the day the chairman summed up the day by suggesting a set of recommendations and then invited everyone to an informal reception.

The distributed agenda suggested the following items for presentation and discussion by the panelists:

1. The Audit: What it should include; extent of analysis; equipment required; follow-up work; real cost; etc.
 2. The Auditors: technical expertise required; private or public sector personnel; etc.
 3. Training: type of training required; how courses will be developed; where training will take place; licensing/certification; etc.
 4. Delivery of the Program: roles of provinces; utilities; private sector/public sector; etc.
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5. Financing of the Audit: How much the homeowner/tenant will be expected to pay; subsidies; how the audit could be tied to the additional eligible work under the assistance program(s); etc.
 6. Steps Required to Develop and Finalize the Audit Program: roles; timing; possible targets; etc.
 7. Rationale for Audit Standards: their appropriateness and possible timing.
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The agenda and panelists were as follows:

INTRODUCTION TO SEMINAR

CREB/EMR _____ David McCann

PANEL 1: U.S. ENERGY AUDIT PROGRAMS

Alaska _____ John Munson
Tennessee Valley Authority _____ W.C. Whisenaut
Princeton University _____ David Harrje
Solar Energy Research Institute _____ Tom Potter and Ken Olsen

PANEL 2: PROVINCIAL AUDIT PROGRAMS

Ontario Hydro _____ Ivan Beare
Québec Hydro _____ Raymond Godbout
Saskatchewan Office of Energy Conservation _____ Fred Heal
George Brown College _____ Zach. Bajin

PANEL 3: EMR PILOT RESIDENTIAL AUDIT PROGRAM

EMR _____ Jack Smith
Nepean Development Consultants _____ Glen Milne
Retrospectors Inc. _____ Sebastian Moffat
Millbank Associates _____ Ron Argue

PANEL 4: AUDIT STANDARDS

Canax Industries _____ Barrie Bradshaw
Capital Home Care _____ Ivan Vicha
CGSB _____ Peter Jones
Thermomaster Inc. _____ Robert Shepherd
Construction Technologies _____ Al Evans

SUMMATION

CREB/EMR _____ David McCann

In his greetings to participants and introduction to the seminar David McCann mentioned that he hoped the seminar would cover a broad range of topics, actors, areas of concern and lessons from experience to date. He also noted the following:

- a. the goals of the National Energy Program to reduce dependency on oil in substitution and conservation and the responsibility of his groups to help achieve those goals in the area of retrofit of low-rise residential buildings,
 - b. his belief that an audit will be cost effective in achieving energy conservation,
 - c. the research underway in the related areas of:
 - pilot audit projects,
 - appropriate conservation measures,
 - payback feasibility of measures to consumer and program costs to Canada,
 - required consumer education,
 - national and regional standards,
 - d. plans to develop a quarterly newsletter to enable those involved in energy audits/surveys to communicate with each other.
-

PANEL 1:

U.S. ENERGY AUDIT PROGRAMS 6

State of Alaska Audit Program: John Munson

This program legislated by State in 1980 to include:

- a. audit,
- b. certification,
- c. training,
- d. up to \$300.00 refund for measures,
- e. up to \$5,000.00 ten year loan at 5% for conservation improvements.

Initially, the program expected 5,000 audits per year, but this number was reached in the first three months of the first year and the program is now up to 30,000 audits per year.

Pricing the audit was a problem. Having started with a price of \$128 per audit, there were soon situations where some auditors were doing six or seven audits per day at \$160 each. Now the program uses a bid procedure rather than a fixed price, and the cost is sometimes as low as \$50.00 each.

In-state resources for training were inadequate, so the program found assistance through the Resource Conservation Service of the Federal Department of Energy. Because the program was in a hurry to get training underway, some of the original out-of-state trainers used were inappropriate to the Alaskan attitudes and approach.

The training is very broad, including heat loss theory, construction, audit procedures, retrofit techniques, HVAC systems, and renewable resources. Training programs are ten days of six-hour

sessions per day. When it started, the training was centred in urban areas and is now being extended into rural areas. Consideration of expanded training programs is currently being studied.

Certification requires passing a written and a practical exam. The certificate currently has an expiration date, but the program has plans for a recertification process which would train auditors in more building types, and for a permanent certification for auditors who perform a minimum number of audits per year.

The audit itself involves actual measurements rather than "guesstimates", and information from the owner. Auditors prepare their calculations using an R38 base, but the owner has the flexibility to select a higher or a lower level. The final calculations include payback periods and savings.

Tennessee Valley Authority: W.C. Whisenaut

The energy audit program started in 1977, and approximately half a million (600,000) audits have been done to date. Of the homeowners who have had audits, over 60% have taken advantage of the loans offered to undertake conservation measures, and approximately 20% do not accept funding but undertake the work anyway.

People who are to be trained as energy advisors must be graduates of a two-year vocational or college program. They receive a three-week training program.

Some energy advisors are TVA employees, and others are private sector. The fee for a survey of the house is \$70.

The survey is a detailed inspection of the building, including crawl space, heaters, attic, and windows, which provides specifications that the consumer can take to a contractor, plus some additional advice on matters such as use of appliances. There is a list of approved contractors.

If the consumer is using electrical heating, he/she can obtain an interest-free loan of up to \$2,000.00 for conservation measures, and all inspection fees will be covered.

Princeton University: David Harrje

The Princeton University program offers a relatively "fully instrumented" audit under its House Doctor program.

Post audit and retrofit research on our projects has shown some dramatic changes in energy use in terms of the building energy use "signature" and demonstrated fuel savings over time.

Indications are that the audit gives a 10-15% saving (before any technical retrofit measures are applied) from on the spot technical adjustments. A further 10% saving is possible from changes in consumer behaviour, with an additional 20% from an investment of \$1000-1500 in technical measures.

This behaviour factor has required monitoring test groups and control samples of test groups very carefully in order to get useful results.

Their auditors use a \$10,000 package of instrumentation, including the blower door, infrared scanners, syringe insertion of exotic gas, etc. to make most effective use of their time within the

house and to spot serious problems that they think just cannot be found otherwise such as:

- fiberglass simply acting as a filter for infiltration air around ducts, etc.,
- convection loops above and below ceiling/attic surfaces,
- ducting system problems,
- accurate readings of actual air leakage (rather than readings from wall area)

They have been developing statistics on the number of air changes per hour for the housing stock they have surveyed.

They are now offering training in a private mode as opposed to through the university.

Their audits cost an average of \$350 for two people working on one building per day. Many teams are offering on-site post-audit service for major problems.

There are over one hundred such audit teams in place, and a requirement for thousands of these in the near future is foreseen.

Solar Energy Research Institute:

Tom Potter and Ken Olsen

SERI is a public/private institute that does work only for the federal government. The Reagan administration is examining possible cutbacks that may affect its work. The Institute has just completed a major survey on audit procedures.

Over one-half of the consumers who have had their houses audited have taken some conservation measures. Some states cover the cost of the audit; others charge a \$15.00 fee per house.

The major problem in delivering effective energy audits is training sufficient people to do the work. Since there is resistance in all states to using out-of-state training materials, SERI has developed model training packages based on materials that states can actually use.

SERI has also completed Installer and Inspector Manuals, copies of which were made available at the seminar.

Some resistance has been encountered from auditors from utilities, who may feel uncomfortable with some of the broader issues associated with conservation and renewable energy sources.

Panel I: Questions and Discussion

Mr. Whisenaut indicated that, of those consumers who obtained an energy audit through TVA, 75-80% undertook conservation measures, 60% using the interest-free loans available and 15-20% doing the work without these loans. Mr. Potter noted that about 80% of the people who went through a SERI energy audit undertook conservation measures, and observed that even the minor procedure of obtaining a loan stops many people from taking action following an audit unless they are personally convinced of significant results.

The experience of both the State of Alaska and TVA is that the response of the consumer to the audit has a great deal to do with the person who is conducting the audit. Explanations, discussion, assistance with how to use the information and use the conservation measures in the house, and general "people" skills

all enhance the effectiveness of the audit and the likelihood of resulting action. This approach is difficult to instill in a training program, unless the people chosen already have this orientation.

Some problems in condensation are resulting from upgraded insulation unless there is adequate ventilation. This problem can be kept to a minimum if it is adequately addressed during the audit and during the actual installation of conservation measures.

The Resource Conservation Service has found that virtually all of the response to its energy audits has been from upper middle class homeowners. TVA puts the emphasis on lower income groups by training senior citizens to reach the older and poorer segments of the community, of which about 11% have been reached to date.

RCS has based its work on a significantly positive cost/benefit analysis of the audit. In addition, though, a Gallup poll has shown that the installation of new systems in the house has the highest impact on changes in consumer behaviour, even more than an audit.

PANEL 2:

PROVINCIAL AUDIT PROGRAMS 12

Ontario Hydro: Ivan Beare

Under a program called REAP (Residential Energy Advisory Program), Ontario Hydro is offering consumers an "Energy Use Survey" which involves an examination of the caulking, weatherstripping, insulation, hot water use, appliance use and heating system in the consumer's home, and a discussion with the consumer of potential energy-saving measures and options for moving off oil.

The surveyor uses standard forms, manuals and consumer information, and provides a pamphlet for the consumer. There is no charge for the survey. Currently, the average duration of a survey is a half-day, but REAP is aiming for a 2-hour timespan. The house's three-year history of home oil use is the basis for determining kilowatt supply, rather than calculations on the house. REAP also builds in the option of improving electrical service.

Ontario Hydro will loan the consumer up to \$2000.00 at current interest rates, payable through monthly payments, to have energy improvements installed in the house.

Hydro's home service representatives are given a one-week training program to enable them to take on this survey function, as an extension of their existing duties. Training is done in one location so that actual materials and equipment can be used.

Hydro-Québec: Raymond Godbout

Hydro-Québec's home energy improvement plan is called Energain Québec. Its ultimate objective is to improve the energy efficiency of one million homes in Québec and thereby reduce their total energy consumption by 32% by the end of the eight-year program.

Homes built before January 1, 1976 are eligible under this program, and priority is being given to homes built before 1961.

The audit is performed on-site and includes an estimate of the amount of money that could be saved through the recommended measures, the investment needed to undertake these measures, and the length of time needed to recover the investment.

A fee of \$25. per dwelling is charged, up to a maximum of \$500.00 for multiple-unit buildings. The fee will be refunded if the consumer carries out all work recommended by the Energain representative.

A measure is considered cost-effective if its cost can be recovered through energy savings within five years if the work is done by the consumer or eight years if done by a contractor.

Consumers can obtain loans to cover the cost of recommended work if carried out by an accredited firm, or the cost of materials for the recommended work if carried out by the consumer. Loans are offered at advantageous interest rates, for a five-year term, up to a maximum of \$3,000.00 per single family home, and \$750.00 per apartment up to a limit of \$750,000.00.

Energain has 154 specialists working across the province, and is aiming for a larger team, able to carry out 100,000 audits per year.

Saskatchewan Office of Energy Conservation:

Fred Heal

An analysis of the Saskatchewan Warm-Up program indicated that consumers who borrowed \$700.00 (at no interest) to install conservation measures saved 22% in energy consumption. Consumers who participated in the CHIP Program saved an average 20 - 25% in energy consumption. A federal/provincial demonstration project to retrofit six houses throughout the province showed a 50% reduction in energy consumption at a cost of \$2,200.00 for a 1976 house of 1100 square feet.

COSP, by encouraging consumers to switch off oil, causes demand for electrical energy, that requires additional capital costs for hydro expansion. In Saskatchewan each consumer change-over costs COSP \$800 and costs the province \$10,000 in hydro capital expansion, so Saskatchewan is encouraging consumers to look at all options in energy conservation. The initiation of an audit program in Saskatchewan is greatly assisted by the existence of a community-based network of institutions trying "pilot" audit programs. (The contact for this area is Ben Nesbitt).

The "people skills" of the auditors are important for working well with the individual consumers and making the audit process credible and useful.

Through experience, the program has learned that contractors do not always perform the changes to the house in the recommended or the most appropriate way.

A wide range of audit procedures need to be developed and tested, to respond to the great variety of conditions in different regions. No one methodology can be appropriate for the entire country. Saskatchewan has tested five different approaches.

In the end, the program adopted an approach combining a walk-through of the house, and the use of instrumentation on-site, followed by a letter to the consumer to present all the data in written form.

One concern is the possible liability of the program for the efficacy of energy conservation measures recommended as a result of the audit. Some technical issues related to conservation measures need to be resolved, including possible condensation from increased insulation, possible changes in indoor air quality, and the reliability and long-term availability of conservation systems and products.

George Brown College: Zach Bajin

George Brown College of Applied Arts and Technology offers a three-year program in energy fundamentals, comprised of general engineering courses, math and science courses, and courses on energy forms. The emphasis is on examining a broad range of energy forms, and conversion of all forms of energy to useful forms. A staff of one faculty member and eight experts from other institutions are responsible for course content. The College recently did a market survey of 305 energy-related companies and identified 175 positions available.

Panel 2: Questions and Discussion

The Ontario Hydro program presents a range of energy options, but the consumer loan is only available for conversion from oil to electrical heating and for insulation measures. The program's priority target group is oil-heating homes.

Including the cost of saws, gas repairs, etc., wood fuel is not a cost-effective solution in many situations.

PANEL 3:

EMR PILOT RESIDENTIAL PROGRAM

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EMR: Jack Smith

The Buildings and Urban Energy Directorate of EMR is responsible for the development of the Enhanced Conservation Assistance Program (ECAP), including:

- related energy policy analysis,
- program research and development (including the energy audit),
- buildings technology,
- research and evaluation on the effectiveness of program instruments.

ECAP is part of COSP, and deals with existing housing and the energy conservation aspects of COSP.

ECAP will offer to consumers in NWT, Yukon, PEI and Newfoundland (areas of the country where gas and electrical are not available as alternatives to oil) a grant to cover 50% of the cost of eligible energy improvements up to \$800.00. Eligible improvements include insulation, air leakage reduction and heating system up-grading. Other measures are being considered for possible inclusion, e.g. air-to-air exchangers and thermography.

ECAP is embarking on the planning and research for a residential audit, with a view to possible implementation in the fall of 1982. Various technical procedures are to be developed and tested through a pilot project in PEI from January to April, and other pilot projects in the two territories and Newfoundland in the spring of 1982.

The PEI pilot project will:

- develop profiles of local housing stock and available labour and materials,
- review current research on audit methodology, including research underway within EMR,
- develop a detailed training program,
- undertake a field audit of 100 - 200 houses.

ECAP has established some objectives to guide the development of the residential audit. The audit should identify for the householder eligible measures to reduce energy consumption, a ranking of those measures in order of priorities, and an estimate of the cost of the measure if done by a contractor or if done by the householder.

The audit procedure should simplify data collection and RSI calculations, and make use of computerized data storage to enable better management, evaluation, etc. The audit should also provide the basis for research, training and evaluation programs.

The audit procedure should be immediately applicable to PEI, easily adaptable to a wide range of homes, and possibly adaptable to other regions.

COSP authorities should be able to use the audit results to evaluate if a consumer's subsequent application for a grant covers the optimal conservation measures.

Finally, the audit should be within the capability of a two-year college level technician with three additional weeks of specialized training.

Two of the major considerations in developing a residential audit relate to who should provide the audit and who should pay for it. The major options for infrastructure to deliver the audit are EMR, private contractors, and non-profit associations. The cost of the audit could be covered by user fees, federal grants as an eligible measures under COSP, demonstration projects fully funded by the federal government, or other as yet unexplored options.

Nepean Development Consultants: Glen Milne

The four provinces and territories to which ECAP applies offer a wide range of diversity in their housing stock, climatic conditions and consumer attitudes.

PEI has a very energy-conscious population, who reached a participation rate in CHIP of 80%, and a housing stock in relatively good condition, situated in a temperate climate. Newfoundland has a climate that is somewhat harsher, and a remoteness from the rest of Canada. Much housing stock is in need of basic retrofit to become energy-efficient. NWT and Yukon, although situated in a cold and bleak landscape, are much less energy-conscious; e.g. NWT participation in CHIP was only 11%. Housing stock is usually inappropriate for the north, and rarely maintains its integrity for more than 3-5 years. Energy options and conservation measures are not well-known, partly because users frequently do not pay heating or utility costs.

The best way to work with such widely varied regions is to help the people in each region develop their own approach to energy conservation. The audit, and the training to carry it out, has to be designed by the people who will use it, initially with

assistance from elsewhere. This is particularly true of the Inuit, Indian and Dene peoples for whom any program must be integrated into their overall socio-economic development.

The ECAP grant is a substantial amount in PEI, but is relatively insignificant in the north, where massive changes in each house are required (for example, building an entire second roof over top of the existing roof) and construction costs are much higher than elsewhere in Canada.

Regionalization should eventually become sufficiently refined that ECAP can respond to those portions of ineligible provinces which do not have alternatives to oil.

Savings accruing from ECAP could be calculated in 1981 dollars, in 1985-86 Alberta Agreement dollars, in OPEC dollars, and in new oil dollars. Macro-economic implications of COSP and ECAP include the impact of capital released from oil mega-projects, and the job creation impact of these mega-projects compared with conservation measures.

Panel 3: Questions and Discussion

Sebastian Moffat from Retrospectors Inc. and Ron Argue from Millbank Associates participated in the technical questions raised in the discussion period, rather than making formal presentations.

Laura Mair, representing the government of PEI noted the province is interested in this topic and pleased to see the pilot project, but looks forward to more sensitivity and better communications in the future.

Concern was expressed that if a government-sponsored energy audit suggested a priority-ranked list of conservation measures, the government would find itself the object of intense lobbying from the various industries affected (insulation, storm windows, siding, etc.) EMR hopes to avoid problems by providing a professional assessment of pay-back periods of different measures, and leaving the actual choice of measures to the consumer. TVA uses this approach and has not encountered difficulties.

There was discussion around the usefulness of complex instrumentation in energy audits. Some participants held that this instrumentation provides the information for the last and most difficult 25% of improvement in energy efficiency. Sebastian Moffat suggested that the time and training required to accurately interpret the data did not make it cost-effective, and that simpler techniques covered most situations. It might be appropriate for the private sector to develop and market this highly specialized expertise.

Regulatory reforms to affect the energy efficiency of new houses is not the responsibility of the section of EMR hosting this seminar, but that issue is being examined by the appropriate EMR section. In addition, the Canadian Standards Association has been interested in the use of the building code for energy conservation, and has structured a committee composed of CSA, HUDAC, Canadian Electrical Association, NRC and EMR, which hopes to have by June, 1982 a test to measure a house's heat loss relatively accurately.

The pilot project is testing various time periods, one of which is based on an average timespan of 2 1/2 hours. It is important

for the time period to be completely open-ended, especially in order to adapt to varied regional situations.

One idea to consider for the future is to allow training courses for the general public to be eligible for funding. There needs to be a full range of training, not only for auditors, but for people in related professions (architecture, engineering, etc.) and trades, for the general public, and particularly for trainers in this area.

The price of the audit will depend on the firms that do the pilot project, and could range anywhere from \$25 to \$300.

PANEL 4:

AUDIT STANDARDS

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Canax Industries: Barrie Bradshaw

An audit should include a review of all the basic components of a house related to energy, including insulation, wall and window areas, fireplaces, chimneys, appliances, the electrical system, and all heat sources. Given the other measures that provide rapid returns, especially insulation, the installation of a new furnace should probably be a lower priority in many cases.

Private industry would be more economical and more responsive in the provision of audits than would the government.

In order to have credibility with the consumer and the contractor, the auditor needs to be professional.

Auditors should receive special training through vocational and trade schools, and be required to pass exams before receiving certificates or licences. Continuing certification should require periodic up-dating.

The real cost of the average audit would be approximately \$150, including 4 hours on-site and 1 hour of clerical/administrative support, plus an additional \$40 for each follow-up call or inspection.

With housing starts down to 50% of previous levels, 50 % of the building inspectors in the country must be looking for useful tasks. Perhaps they could be retrained as auditors.

Capital Home Care: Ivan Vicha

Capital Home Care, an insulation company which has moved into audits and other energy-related services and products, has expanded the Enersave questionnaire in order to

- make it more responsive to individual situations,
- include measurement of heat loss,
- include the recent NRC method of estimating energy savings from reinsulating houses.

The major energy conservation measures can be ranked in general order of priority, which shows the order in which they should be undertaken, as follows:

1. energy audit,
2. air sealing,
3. insulation and ventilation,
4. windows and doors,
5. furnace sizing, which should be last in order to adjust the furnace to the new lower required level of heating.

CGSB: Peter Jones

CGSB accredits standard, certification and testing organizations in Canada. There are five standards organizations:

- CSA
 - Canadian Gas Association
 - Underwriters Association
 - Bureau de normalisation de Québec
 - Canadian Standards Board
-

Voluntary standards are developed through committees which bring together representatives from all interested parties, so as to address confrontations person-to-person rather than through the market place.

The committee oversees the development of performance specifications for goods or services, through a series of drafts that are thoroughly discussed, dissected and re-directed. The final draft reflects regional variations and general consensus to the extent possible. This document is then sent to a second level of review which examines the representation on the committee, the way in which dissent was managed, and the significance of the areas of disagreement.

Thermomaster Inc.: Robert Shepherd

The cellulose insulation industry provides a graphic illustration of problems that might arise if audit standards are not established early on.

The industry started up largely in response to the growing demand for insulation resulting from the CHIP program. There were no standards for cellulose insulation, and the industry grew to over 80 manufacturers in Canada and over 800 in the United States. Many of these manufacturers were not producing high quality insulation, and when the standards eventually were established, the number of manufacturers dropped to 35 in Canada and 200 in the United States.

Develop a standard early on and many later problems will be avoided.

Panel 4: Questions and Discussion

Al Evans from Construction Technologies did not make a formal presentation, but rather participated in the discussion and question period.

NRC has produced a useful reference document on Estimated Energy Savings from Insulating Houses, Building Practice Note # 20, 51-42 CGSB.

There is a need for a central forum to gather and co-ordinate all work in this area, given that there are at least eight different agencies at the federal level alone working on energy audits. EMR headquarters was suggested as a possible focus point for this forum. Provinces need to be involved in the process, not only because they are undertaking their own research, but also because they will be responsible for eventual implementation and administration of any standards that apply to the building industry.

Upper income householders will be able to locate and hire private auditors, but there also needs to be service available to lower income families. It might be possible to deliver this new service through existing programs such as RRAP.

It is highly likely that private industry will develop a widely available audit before the government does, and will deliver the audit for commercial reasons. A standard is the best way to manage that situation for the interests of the consumer.

Any standard should include distinctions between urban and remote settings. The standard should also cover estimated savings and pay-back periods, so that consumers are not in the position of undertaking extensive changes to their house for relatively minor energy improvements.

The Ontario Ministry of Housing is interested in developing a business practice standard to govern the activities of auditors, rather than standards for the audit as a product.

David McCann suggested three recommendations he would make to the federal department of Energy, Mines and Resources for action, based on the discussions at the seminar:

1. EMR would support the position of the Ontario Ministry of Housing to start the development of standards by focussing on business practice.
2. EMR would take responsibility for gathering information on energy audit procedures and standards for those procedures.
3. EMR would undertake to widely disseminate this information on a quarterly basis, through a newsletter or equivalent format.



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